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(71) Applicants
Imperial Chemical
Industries Limited,
Imperial Chemical House,
Millbank, London
SW1P 3JF
(72) Inventors
John Peter Brown,
Robert Stuart Hampson,
Peter McDermott
(74) Agent
Michael James Ricks,
Imperial Chemical
Industries Limited, Legal
Department: Patents,
Thames House North,
Millbank, London
SW1P 4QG

(54) Isocyanate-containing emulsions and their use in a process for manufacturing sheets or moulded bodies

(57) An isocyanate emulsion comprises
(a) water;
(b) an organic polyisocyanate;
(c) a non-ionic surface active agent of the formula:

$$RO(CH_2CH_2O)_nCONHX$$

in which R is an alkyl group having from 1 to 4 carbon atoms, n is an integer such that the compound contains an average of at least 5 oxyethylene groups and X is the residue of a polyisocyanate and contains at least one free isocyanate group, the surface active agent having been prepared *in situ* in the polyisocyanate by reacting with it an appropriate amount of an alcohol of the formula:

$$RO(CH_2CH_2O)_nH$$

and
(d) a thickening agent in sufficient amount to give the emulsion a viscosity of 2 to 10,000 centipoises at 25°C.

A preferred thickening agent is guar gum.

Uses:—In the manufacture of sheets or moulded bodies by the hot pressing of a mass of lignocellulosic material with the isocyanate emulsion.

GB 2 075 038 A

SPECIFICATION

Isocyanate-containing emulsions and their use in a process for manufacturing sheets or moulded bodies

This invention relates to isocyanate-containing emulsions, their manufacture and use as binding agents.

Emulsions of organic polyisocyanates in water are well known and are useful as binding agents, for example in the manufacture of particle board. Isocyanate-containing emulsions may be classified into two categories according to the manner in which the surfactant is incorporated. Thus emulsions may be prepared from organic polyisocyanates containing an "internal surfactant" i.e. a surfactant which is present in admixture with the organic polyisocyanate so that an emulsion is formed on addition of water to the isocyanate/surfactant mixture. Alternatively the surfactant (an "external surfactant") may be incorporated in the water phase prior to emulsification with the organic polyisocyanate.

Examples of typical "internal surfactant" systems are given in United Kingdom Patent Specification No. 1444933 and in United Kingdom Patent Application No. 7905734 published as GB 2018796A.

The use of aqueous emulsions of organic polyisocyanates offers a number of advantages to the particleboard manufacturer. One of these advantages is the ease with which the low viscosity emulsions can be applied to lignocellulosic material using conventional equipment, particularly spray equipment. In some cases, however, the low viscosity of the isocyanate emulsions can be a disadvantage. Thus, when the emulsions are applied to wood chips using centrifugal or smear blenders, they can be distributed unevenly and the properties of the resulting particleboard are adversely affected.

In order to minimise this problem, the present invention provides an isocyanate emulsion comprising

(a) water;

(b) an organic polyisocyanate;

(c) a non-ionic surface active agent of the formula:

$$RO(CH_2CH_2O)_nCONHX$$

in which R is an alkyl group having from 1 to 4 carbon atoms, n is an integer such that the compound contains an average of at least 5 oxyethylene groups and X is the residue of a polyisocyanate and contains at least one free isocyanate group, the surface active agent having been prepared *in situ* in the polyisocyanate by reacting with it an appropriate amount of an alcohol of the formula:

$$RO(CH_2CH_2O)_nH$$

and

(d) a thickening agent in sufficient amount to give the emulsion a viscosity of 2 to 10,000 centipoises at 25°C.

The thickening agent present in the emulsions of the invention is a material of a polymeric nature which forms an aqueous solution having a significantly higher viscosity than that of water itself. Such materials, which are well known in the textile printing art for the thickening of print pastes, include natural materials of a gelatinous or gummy nature, usually having a polysaccharide structure, and some synthetic polymers.

Examples of suitable thickeners include mannogalactans such as guar and locust bean gums, alginates, hydroxyalkyl and carboxyalkyl celluloses, xanthan, starch and polyacrylic acid and ethylene-maleic anhydride polymers.

The thickening agent may be dissolved in the isocyanate emulsion in any convenient manner, the preferred thickener being guar gum. The thickener is preferably used in an amount to give an emulsion having a viscosity of from 200 to 500 centipoises at 25°C.

The organic polyisocyanates which may be used are fully described in UK Patent Specification No. 1444933. They include isocyanate-ended prepolymers made by reaction of an excess of a polyisocyanate with a hydroxyl-ended polyester or polyether and products obtained by reacting an excess of a polyisocyanate with a monomeric polyol. Preferably the isocyanate is a crude mixture of polymethylene polyphenyl polyisocyanates containing di-, tri- and higher functionality polyisocyanates. This isocyanate is known as crude MDI and is prepared by phosgenating a mixture of the polyamines obtained by condensing aniline and formaldehyde.

The surface active agent used in the invention and its method of preparation are also described in UK Patent Specification No. 1444933. Preferably the integer n has an average value of from 5 to 120 and especially 10 to 25. The group R includes ethyl, propyl and butyl and is preferably methyl. The group X is the residue of a polyisocyanate with one isocyanate group removed. Isocyanates from which the group X can be derived are any of those which may be used as the polyisocyanate component of the invention. The surface active agent is preferably a reaction product of the polyisocyanate and a methoxy polyethylene glycol of molecular weight 300 to 1000, particularly 650. The surface active agent may be present in the amounts described in UK Patent Specification No. 1444933 and GB 2018796A.

The emulsions are of the oil in water type and can be obtained by mixing from 3 to 60 parts by weight of the isocyanate with 97 to 40 parts by weight of water, preferably 14 to 50 parts isocyanate with 86 to 50 parts of water.

The emulsions of the present invention are useful as adhesives, binders and surface coatings. Examples of suitable applications are given in UK Patent Specification Nos. 1444933 and 1502777.

In our UK Patent Specification No. 1523601 there is described and claimed a process for

manufacturing sheets or moulded bodies, especially chipboard, which comprises hot pressing a mass of lignocellulosic material mixed with a binding agent comprising an aqueous emulsion of an organic polyisocyanate. The emulsions of the present invention are particularly useful for this application.

Thus according to a further aspect of our invention we provide a process for manufacturing sheets or moulded bodies comprising hot pressing a mass of lignocellulosic material mixed with an aqueous emulsion of the invention.

Lignocellulosic material which can be used in the process includes wood chips, wood fibres, shavings, wood wool, cork and bark, sawdust and like waste products from the woodworking industry, and/or fibres from other natural products which are lignocellulosic for example begasse, straw, flax residues and dried rushes, reeds and grasses. Additionally there may be mixed with the lignocellulosic material inorganic flake or fibrous material e.g. glass fibre, mica or asbestos.

The process may be carried out by spraying the lignocellulosic material with the emulsion while it is being tumbled in a mixer but, because of their viscosity, the emulsions of the present invention are particularly suitable for applying to the lignocellulosic material using a centrifugal smear blender, for example a Lodige-Littleford blender.

After the application of the emulsion, the lignocellulosic material may be hot pressed by methods fully described in the prior art.

The higher viscosity emulsions are also useful as glues in the preparation of laminated materials such as plywood.

The invention is illustrated but not limited by the following Example in which all parts and percentages are by weight.

EXAMPLE

An emulsifiable isocyanate is prepared by reacting 3 parts of methoxy polyethylene glycol (molecular weight 650) with 97 parts of crude MDI having an NCO content of 30% and containing approximately 50% of diphenylmethane diisocyanates, the remainder being polymethylene polyphenyl polyisocyanates of higher functionality.

A self-hydrating dispersible guar gum is dissolved in water to give a solution having a viscosity between 200 and 500 centipoises at 25°C.

The emulsifiable MDI is then injected at high pressure into the aqueous solution to give an emulsion having an NCO content of 12.5%. When applied to wood chips using a centrifugal smear blender, uniform distribution of the emulsion is achieved and the final press-cured board has better physical properties than a product made from an unthickened emulsion.

CLAIMS

1. An isocyanate emulsion comprising
(a) water;
(b) an organic polyisocyanate;
(c) a non-ionic surface active agent of the formula:

$$RO(CH_2CH_2O)_nCONHX$$

in which R is an alkyl group having from 1 to 4 carbon atoms, n is an integer such that the compound contains an average of at least 5 oxyethylene groups and X is the residue of a polyisocyanate and contains at least one free isocyanate group, the surface active agent having been prepared *in situ* in the polyisocyanate by reacting with it an appropriate amount of an alcohol of the formula:

$$RO(CH_2CH_2O)_nH$$

and
(d) a thickening agent in sufficient amount to give the emulsion a viscosity of 2 to 10,000 centipoises at 25°C.

2. An isocyanate emulsion according to claim 1 wherein the thickening agent is a mannogalactan.

3. An isocyanate emulsion according to claim 2 wherein the thickening agent is guar gum.

4. An isocyanate emulsion according to any of the preceding claims wherein the thickening agent is used in an amount to give an emulsion having a viscosity of from 200 to 500 centipoises at 25°C.

5. An isocyanate emulsion according to any of the preceding claims containing from 3 to 60 parts by weight of the organic polyisocyanate and from 97 to 40 parts by weight of water.

6. An isocyanate emulsion according to claim 5 containing from 14 to 50 parts by weight of the organic polyisocyanate and from 86 to 50 parts by weight of water.

7. A process for manufacturing sheets or moulded bodies comprising hot pressing a mass of lignocellulosic material mixed with an isocyanate emulsion according to any of claims 1 to 6.

8. A process according to claim 7 wherein the isocyanate emulsion is applied to the lignocellulosic material using a centrifugal smear blender.

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